

3.16 Polar Coordinates

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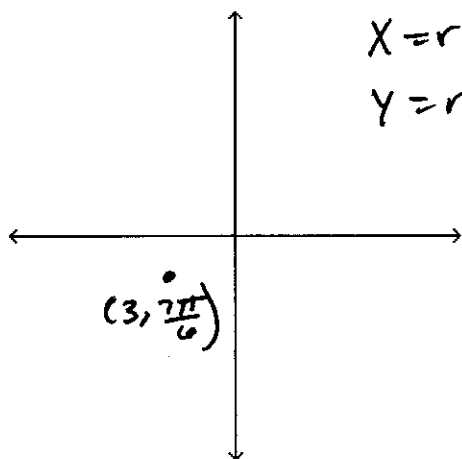
Name _____ Date _____ Period _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Find the rectangular coordinates of the point with the given polar coordinates.

1)

1) $\left(-\frac{3\sqrt{3}}{2}, -\frac{3}{2}\right)$



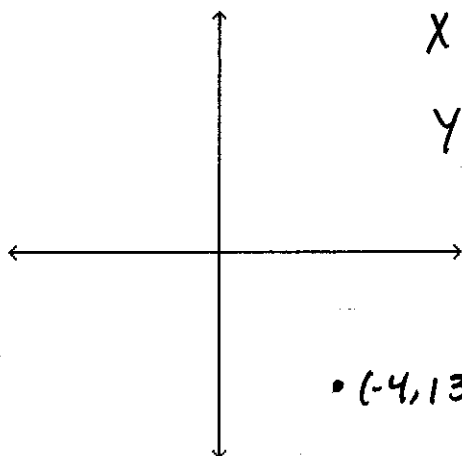
$$x = r \cos \theta$$

$$y = r \sin \theta$$

$$x = 3 \cdot \cos \frac{7\pi}{6} = -\frac{3\sqrt{3}}{2}$$

$$y = 3 \sin \frac{7\pi}{6} = -\frac{3}{2}$$

2)



$$x = -4 \cos 135^\circ = -\frac{4\sqrt{2}}{2} = -2\sqrt{2}$$

$$y = -4 \sin 135^\circ = -\frac{4\sqrt{2}}{2} = -2\sqrt{2}$$

3) $(1.5, 7\pi/3)$

$$x = 1.5 \cos \left(\frac{7\pi}{3}\right) = \frac{3}{2} \cdot \frac{1}{2} = \frac{3}{4}$$

$$y = 1.5 \sin \left(\frac{7\pi}{3}\right) = \frac{3}{2} \cdot \frac{\sqrt{3}}{2} = \frac{3\sqrt{3}}{4}$$

3) $\left(\frac{3}{4}, \frac{3\sqrt{3}}{4}\right)$

4) $(-3, 29\pi/7)$

$$x = -3 \cos \left(\frac{29\pi}{7}\right) = -2.70$$

$$y = -3 \sin \left(\frac{29\pi}{7}\right) = -1.30$$

4) $(-2.7, -1.3)$

5) $(-2, \pi)$

$$x = -2 \cos \pi = (-2)(-1) = 2$$

$$y = -2 \sin \pi = (-2)(0) = 0$$

5) $(2, 0)$

6) $(2, 270^\circ)$ $x = 2 \cos 270^\circ = (2)(0) = 0$
 $y = 2 \sin 270^\circ = (2)(-1) = -2$

6) $(0, -2)$

7) $(-3, 360^\circ)$

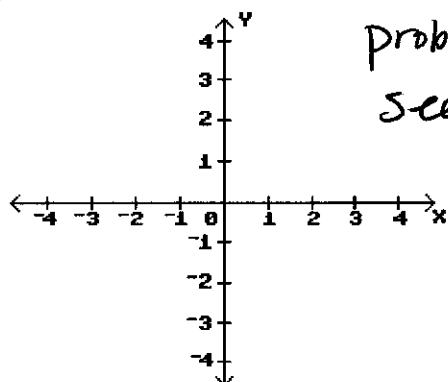
$x = -3 \cos 360^\circ = (-3)(1) = -3$
 $y = -3 \sin 360^\circ = (-3)(0) = 0$

7) $(-3, 0)$

Plot the point with the given polar coordinates.

8) $\left(3, \frac{4\pi}{3}\right)$

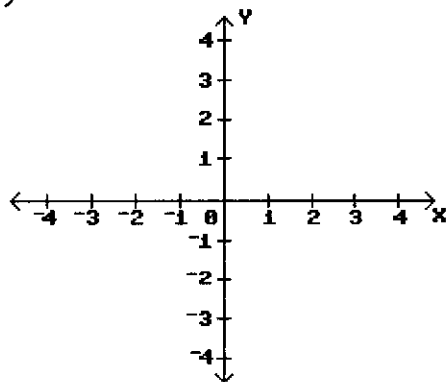
8) _____



problems 8-11
 see polar graphs
 on back!
 =

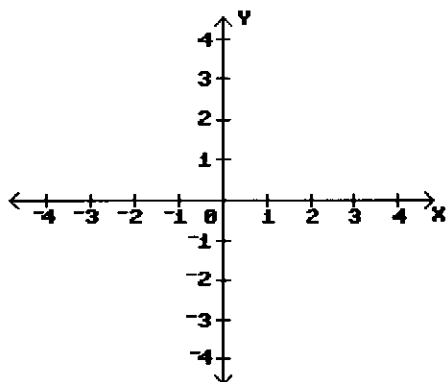
9) $\left(-1, \frac{2\pi}{5}\right)$

9) _____



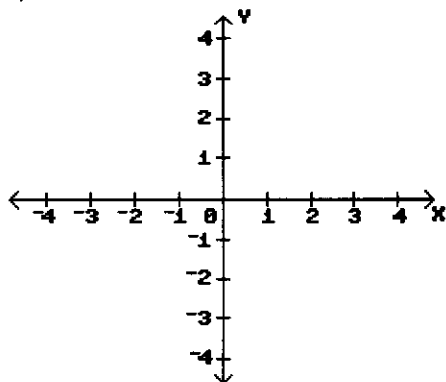
10) $(2, 30^\circ)$

10) _____



11) $(-2, 120^\circ)$

11) _____



The polar coordinates of point P are given. Find all of its polar coordinates for $(-2\pi \leq \theta \leq 2\pi)$.

12) $P = (2, \pi/6)$ $(2, -11\pi/6)$ $(-2, -5\pi/6)$ $(-2, 7\pi/6)$

12) _____

13) $P = (1.5, -20^\circ)$ $(1.5, 340^\circ)$ $(-1.5, 160^\circ)$ $(-1.5, -200^\circ)$

13) _____

14) $P = (1, -\pi/4)$ $(1, 7\pi/4)$ $(-1, 3\pi/4)$ $(-1, -5\pi/4)$

14) _____

15) $P = (-2.5, 50^\circ)$ $(2.5, -130^\circ)$ $(-2.5, -310^\circ)$ $(2.5, 230^\circ)$

15) _____

Rectangular coordinates of point P are given. Find all polar coordinates of P that satisfy

a) $0 \leq \theta \leq 2\pi$ b) $-\pi \leq \theta \leq \pi$ c) $0 \leq \theta \leq 4\pi$
 \rightarrow point in quadrant I.

16) $P = (1, 1)$ a) $(\sqrt{2}, \pi/4)$ & $(-\sqrt{2}, 5\pi/4)$

16) _____

(r, θ)
 $r = \sqrt{x^2 + y^2}$
 $\theta = \tan^{-1}(\frac{y}{x})$

b) $(\sqrt{2}, \pi/4)$ & $(-\sqrt{2}, -3\pi/4)$

c) $(\sqrt{2}, \pi/4)$ $(-\sqrt{2}, 5\pi/4)$ $(\sqrt{2}, 9\pi/4)$ $(-\sqrt{2}, 13\pi/4)$

check for correct quadrant.

17) $P = (1, 3)$

Quad. 1
a) $(\sqrt{10}, 1.25) + (-\sqrt{10}, 4.39)$

17) _____

b) $(\sqrt{10}, 1.25) + (-\sqrt{10}, -1.89)$

18) $P = (-2, 5)$

Quad. 2
a) $(\sqrt{29}, 1.95) + (-\sqrt{29}, 5.09)$

c) $(\sqrt{29}, 1.95) + (-\sqrt{29}, 5.09)$

18) _____

b) $(-\sqrt{29}, -1.19) + (\sqrt{29}, 1.95)$

$(\sqrt{29}, 8.23) + (-\sqrt{29}, 11.38)$

19) $P = (-1, -2) \rightarrow \text{Quad. 3}$

a) $(-\sqrt{5}, 1.11) + (\sqrt{5}, 4.25)$

c) $(-\sqrt{5}, 1.11) + (\sqrt{5}, 4.25)$

19) _____

b) $(-\sqrt{5}, 1.11) + (\sqrt{5}, -2.03)$

$(-\sqrt{5}, 7.39) + (\sqrt{5}, 10.53)$

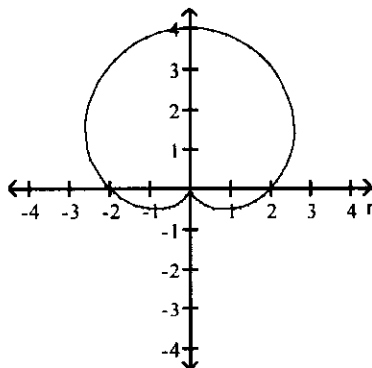
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use your grapher to determine which of the graphs matches the given polar equation.

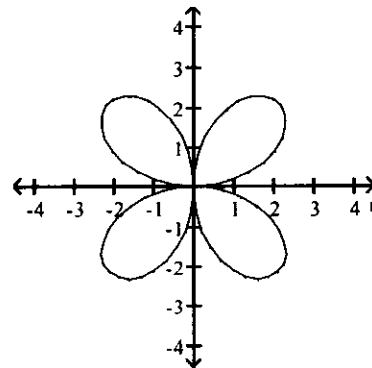
20) $r = 3 \sin 2\theta$

20) B

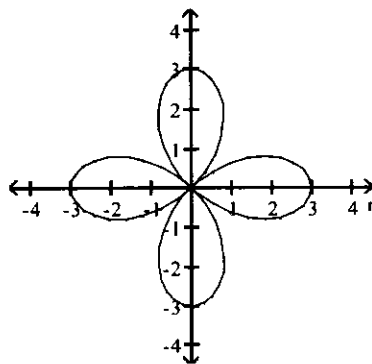
A)



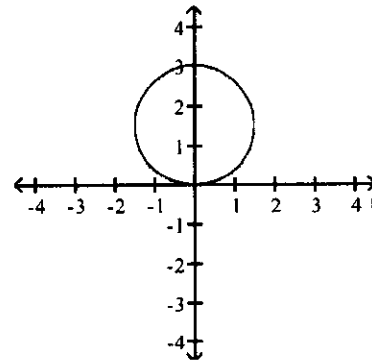
B)



C)



D)



SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Find an equivalent equation in polar coordinates.

21) $x = 2$

21) $r = \frac{2}{\cos \theta}$

$x = r \cos \theta$

so, $2 = r \cos \theta$, solve for r .

$\frac{2}{\cos \theta} = \frac{r \cos \theta}{\cos \theta}$

22) $x = 5$

$$\frac{5}{\cos \theta} = \frac{r \cos \theta}{\cos \theta}$$

22) $r = \frac{5}{\cos \theta}$

23) $2x + 3y = 5$

$$x = r \cos \theta, y = r \sin \theta$$

$$2r \cos \theta + 3r \sin \theta = 5$$

$$\frac{r(2 \cos \theta + 3 \sin \theta)}{2 \cos \theta + 3 \sin \theta} = \frac{5}{2 \cos \theta + 3 \sin \theta}$$

24) $3x + 4y = 2$

$$3r \cos \theta + 4r \sin \theta = 2$$

$$r(3 \cos \theta + 4 \sin \theta) = 2$$

$$r = \frac{2}{3 \cos \theta + 4 \sin \theta}$$

24) _____

25) $(x-3)^2 + y^2 = 9$

$$x^2 - 6x + 9 + y^2 = 9$$

$$x^2 + y^2 - 6x = 0$$

$$r^2 - 6r \cos \theta = 0$$

Factor out r.

$$r(r - 6 \cos \theta) = 0$$

$$r = 0 \text{ or } r - 6 \cos \theta = 0$$

solve for r.

$$r = 6 \cos \theta$$

25) _____

26) $x^2 + (y-1)^2 = 1$

$$x^2 + y^2 - 2y + 1 = 1$$

$$x^2 + y^2 - 2y = 0$$

$$r^2 - 2r \sin \theta = 0$$

$$r(r - 2 \sin \theta) = 0$$

$$r = 0 \text{ or } r = 2 \sin \theta$$

26) _____

27) $(x+3)^2 + (y+3)^2 = 18$

$$x^2 + 6x + 9 + y^2 + 6y + 9 = 18$$

$$x^2 + y^2 + 6x + 6y = 0$$

$$r^2 + 6r \cos \theta + 6r \sin \theta = 0$$

$$r(r + 6 \cos \theta + 6 \sin \theta) = 0$$

$$r = 0 \text{ or } r = -6 \cos \theta - 6 \sin \theta$$

28) _____

28) $(x-1)^2 + (y+4)^2 = 17$

$$x^2 - 2x + 1 + y^2 + 8y + 16 = 17$$

$$x^2 + y^2 - 2x + 8y = 0$$

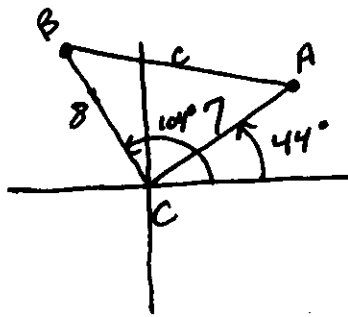
$$r^2 - 2r \cos \theta + 8r \sin \theta = 0$$

$$r(r - 2 \cos \theta + 8 \sin \theta) = 0$$

$$r = 0 \text{ or } r = 2 \cos \theta - 8 \sin \theta$$

Solve the problem.

- 29) The locations, given in polar coordinates, of two ships are (7 mi, 44°) and (8 mi, 104°).
Find the distance between the two ships.



$$\angle C = 104^\circ - 44^\circ = 60^\circ$$

Use Law of Cosines: SAS

$$c^2 = 8^2 + 7^2 - 2(8)(7) \cos 60^\circ$$

$$c^2 = 57$$

$$c = \sqrt{57} \approx 7.55 \text{ mi}$$

29) _____

Find an equivalent equation in rectangular coordinates.

30) $r = 10 \sin \theta$

multiply both sides by r !

$$r \cdot r = 10 \cdot r \sin \theta$$

$$r^2 = 10r \sin \theta$$

$$x^2 + y^2 = 10y \Rightarrow \boxed{x^2 + y^2 - 10y = 0}$$

30) _____

31) $r(\cos \theta - \sin \theta) = 4$

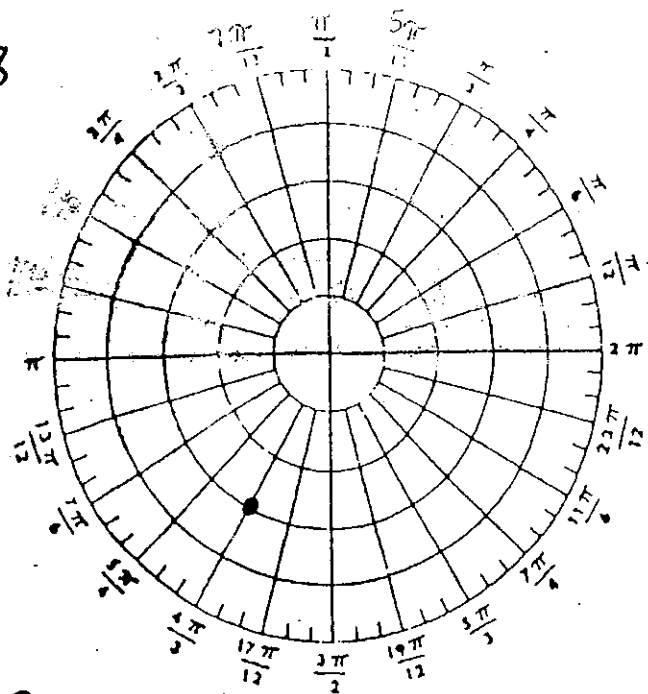
$$r \cos \theta - r \sin \theta = 4$$

$$x - y = 4$$

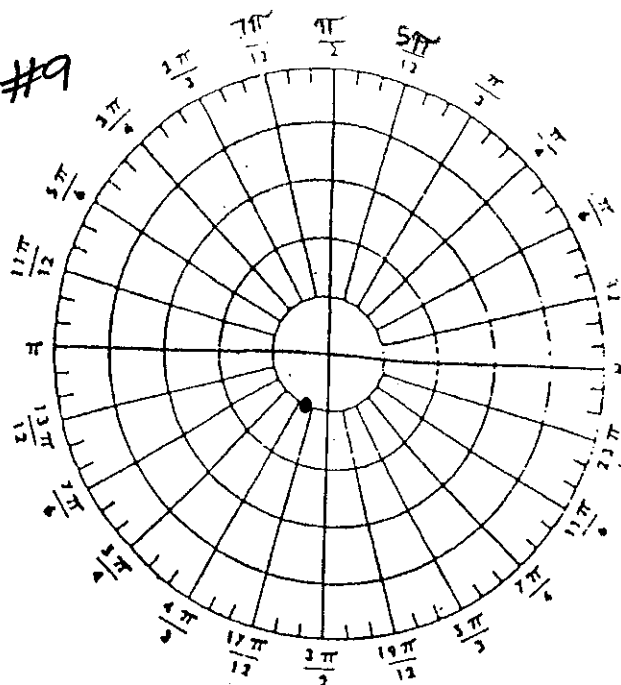
$$\boxed{y = x - 4}$$

31) _____

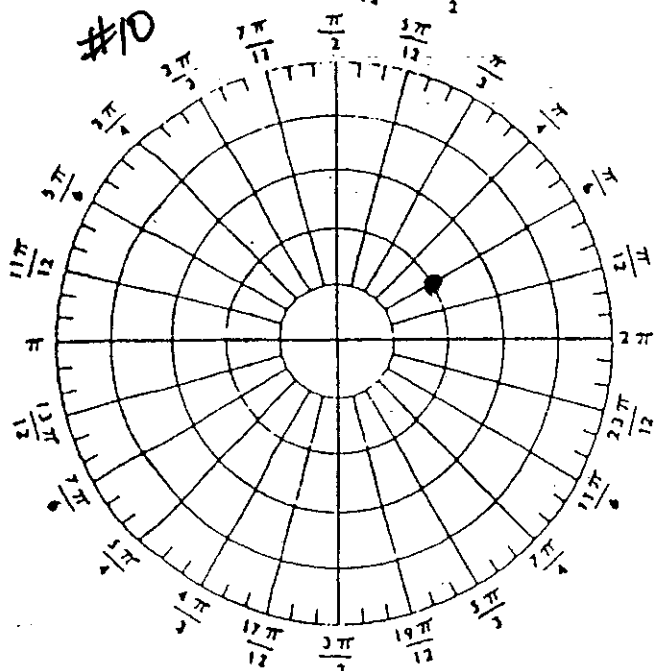
#8



#9



#10



#11

